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THE PROPER CONTENT OF A STANDARD TEST

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The work of measurement in education, using the term broadly enough to include the measurement of mental and physical ability as well as the measurement of subject-matter, bids fair to do more than any other single piece of work to place education on a scientific basis. Since the beginning of work along this line in this country, and its promotion under men like Thorndike, Ayres, Strayer, Judd, Courtis, and others, education has gone forward by leaps and bounds. No progressive educator can fail to appreciate the immense significance of this work.

But every true educator before undertaking to measure a piece of school work should be zealous to ascertain that the right and desirable thing is being measured. This is the first essential in all testing, and especially in all efforts to formulate standard tests or scales. Tests used strictly for diagnostic purposes without any attempts to set standards, may, as they develop, be found to need a different guiding principle.

This first essential has evidently been neglected in a recently proposed test of ability to place the decimal point[1]. This is the more surprising in view of the valuable work of the author in applying standard tests to public-school work. Before "constructing a series of tests" to test this ability, the author should have raised the question "How much work in decimals is needed to meet the actual conditions of business and of life?" This is the fundamental question. A second question, a little less fundamental, is: "What is the correct method to use in division of decimals?" Let us notice the second question first. The answer to this question has already appeared, first in the Connersville Course of Study in Arithmetic and secondly in an article by Mr. Drushel, which appeared in the May, 1917, number of the *Elementary School Journal.* The reader who will refer to these sources will see that the correct process for division of decimals (barring disproof through further experimentation) is the so-called Austrian method, which reduces the divisor to a whole number by moving the decimal point to the right, and changes the dividend in equal ratio by moving its decimal point the same number of places to the right. The form is arranged so that the quotient is placed above the dividend. Thus arranged, the decimal point in the quotient is simply placed above the decimal point in the dividend, and the difficulty of placing the decimal point disappears. Results from the use of this process are so much superior to the old method through learning the rule for pointing off, that it should be adopted to the entire exclusion of the old method.

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[1] Walter S. Monroe, "Ability to Place the Decimal Point in Division," *Elementary School Journal*, December, 1917.

Dr. Monroe's Decimal Test I does not necessarily imply the use of the old method, but its form suggests and will quite surely lead to the old method, and therefore it is unsatisfactory. In his recently issued standardized tests in decimals, Tests 17, 19, and 21 relate to the ability to place the decimal point, and Tests 17 and 19 make use of the old form. Test 20 uses the Austrian form.

The question whether or not Dr. Monroe's test involves useless subject-matter is one that is much more fundamental and more difficult to answer. The tests in his preliminary study and in his later standardized forms are evidently based upon the usual textbook matter. (The question of social utility has not been raised. Rice raised this question in arithmetic (and spelling) over twenty years ago. McMurry urged the same question at the 1904 meeting of the Department of Superintendence. The writer a year ago[1] and Mitchell during the present year[2] gave data showing that the textbook supply of subject-matter in arithmetic is quite different from the social demand. The writer has since completed the study[3] reported on in a preliminary way in the *Sixteenth Yearbook*, and the larger study supports fully the preliminary study.

The study involves the analysis of 14,583 problems secured through twenty-three school systems in Iowa, Kansas, and Minnesota, and a large number of rural schools throughout Iowa. The problems were gathered throughout the school year and were secured from adults representing practically every occupation in the census. The distribution is typical of the United States as a whole. Without going into details as to the source of the data and the method of handling them, it may be said at this point that the author's advisers consider the study extensive enough to show the actual social and business needs of arithmetic. This study showed that United States money was involved in 88 per cent. of the 14,583 problems, and that arithmetic is seldom used by adults except in a transaction involving buying or selling, and therefore involving United States money. This means extensive use of dollars and cents in simple problems such as occur in ordinary business transactions. This fact seems to be fundamental enough to enable us to urge that dollars and cents be involved from the very beginning of the work in numbers and that no distinction be made between United States money, and ordinary numbers. None of the simple problems in United States money involved the use of a divisor containing decimals as used in Dr. Monroe's preliminary Tests II and III, or his standardized Tests 17, 19, and 21.

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[1] *Sixteenth Yearbook of the National Society for the Study of Education*, Part I, chap. VIII.

[2] A. Edwin Mitchell, "Some Social Demands of the Course of Study in Arithmetic," *Seventeenth Yearbook of the National Society for the Study of Education*, Part I, chap. I.

[3] G. M. Wilson, "A Survey of the Social and Business Usage of Arithmetic," *Teachers College Publications* (in press).

Aside from simple United States money, decimals, as such, appeared in only seven of the 14,583 problems. It will be worth while in view of this statement to note exactly what the seven problems were. Four of them involved buying gasoline at 15.9, 19.9, 21.7, and 22.5 cents respectively. One related to the distance, 0.008 of an inch, traveled by a drill press per revolution. Another involved finding the circumference of a tent, and thus required the use of either, 3.1416 or 3 1–7 in the solution. The other problem was not a real problem. It was a druggist's inquiry on the number of cubic feet of oxygen in a room, the percentage of oxygen by volume being 20.94 per cent. These seven decimals were the only ones reported in the entire list of 14,583 problems, gathered from twenty-three cities in three different states throughout the school year 1916-17, each parent reported upon being asked to list all problems used during a period of two weeks. It will be observed that four of these problems involve a simple use of United States money.

The slight extent to which decimals, as such, are used should make an educator hesitate to prescribe drill in decimals, apart from United States money, sufficient to enable a seventh- or eighth-grade pupil successfully to pass Monroe's preliminary Decimal Tests II or III. The question should be raised even more vigorously in the case of his standardized decimal tests. His preliminary Decimal Test I is in keeping with common business usage, since it does not use any decimals in the divisors, but only whole numbers from 2 to 9. The reader should make the necessary distinction between common business usage and special vocational usage.

This situation (the fact that one of our best-trained investigators should devise a set of tests to test a socially useless product) emphasizes the desirability of testing only after the proper subject-matter has been selected. If tests are to be made indiscriminately for all kinds of subject-matter, we are likely to have fixed upon us undesirable practices through the glorification which results from the application of a standard test to any piece of school work.

Some may question the desirability of basing school work upon adult usage. The most obvious objection is that the arithmetic used by adults in the complicated affairs of business is too difficult for twelve- and fourteen-year-old grade children. But when it is discovered that the adoption of adult usage as a basis for the course of study in arithmetic would give a much simpler program than is now common in the schools, this objection must be withdrawn. On the other hand, it is possible that in training a new generation the schools must go beyond present adult usage. This is evidently correct in teaching the use of arithmetic in large business projects through motivated problems. On the other hand, the schools are going far beyond general social needs in the abstract and mechanical phases of arithmetic, of which the division of decimals is a fair sample. When there are so many urgent demands upon the time of the schools, it is unfair that useless traditional subject-matter, even in arithmetic, should be kept in the course, either through the inertia of the schools or through the force of such educational fallacies as formal discipline, necessity of over-training, or democratizing the masses through a common modicum of knowledge. Manifestly, in any case, the final results are more desirable if the pupil is working upon useful subject-matter than if he is working upon useless subject-matter. If its uselessness is too apparent, he leaves school.

All of this means that we must begin to scrutinize subject-matter more closely in the light of the aim of education and see to it that the aim is not missed through blind adherence to tradition. The aim of education, social efficiency, has been analyzed into four large factors: (1) physical efficiency, or individual health and community sanitation; (2) vocational efficiency, or specific ability to earn a living through following a recognized vocation; (3) civic and moral efficiency (and the accomplishment of this aim means a program quite different from any the schools in general have heretofore put on); (4) avocational efficiency, or education for leisure.

Mastery of the tools of knowledge, should be added to the foregoing either as part of (2) or as a fifth item. The point is usually included under (2), since an individual cannot be vocationally efficient without a mastery of the tools of knowledge sufficient to enable him to meet the requirements of earning a living. Arithmetic can quite surely be placed here, and in turn the work in arithmetic should be limited in the grades to the demands of common business usage.

The difficulty of wisely selecting the material for a test increases as we go from the more mechanical subjects like writing, spelling, and arithmetic to the less mechanical subjects like history, physiology, and geography. In writing, the work was *relatively* simple. Speed and quality were to be measured, and are measured by thousands of teachers today who will never understand the complicated statistical methods by which our first writing scale was derived and who are entirely oblivious to the difficulties still blocking the way to an agreement upon standards in handwriting. In spelling, the task has not been so simple. While Ayres has formulated a scale based upon a well-selected word-list, there has been formulated at least one other spelling test which is based upon the spelling of the entire dictionary. The latter test when fully comprehended is seen to be unwise, if not ridiculous. Spelling is a content subject, and so the formulation of a test involves judgment as to the proper selection of the word-list. While the Ayres scale may not be perfect, it does at least have the first prerequisite of being based upon carefully selected subject-matter. The difficulty of using good judgment increases as we pass to the subjects that are valuable in about the same proportion as they are organized on a problem basis, such as history, physiology, and geography. While not attempting to discuss tests which have been devised for some of these subjects, it should be remarked in passing that such tests should be carefully scrutinized before use. They may tend to formalize and reduce to a mechanical basis subjects that are chiefly valuable to the extent that they get away from formal textbook treatment. Standardizing a typical set of Regents' examination questions does not change the character of the questions.

It is not the purpose of this article to discuss standard tests in general, but to call attention to the evident fact that in the preliminary tests of ability to place the decimal point the author of the test has suggested an antiquated and inefficient procedure, and has failed to limit the subject-matter of the test to the imperative demands of social and business usage. These defects are continued, and to an extent intensified, in the standardized tests which appeared shortly after these preliminary tests. Educators should be slow to accept a standard test which involves relatively useless subject-matter or formal subject-matter more difficult than required by the social and business demands of the community. The measurement of subject-matter, valuable as it is, must be considered subordinate to its proper selection. Dr. Monroe would quite surely be among the first to subscribe to these statements, and it should be added in justice to him that the large studies on the social and business usage of arithmetic referred to in this article were not available at the time the preliminary and standardized tests in the division of decimals were devised.